Technical Report

on the

Concept

of the

Safety component

Digital Input card

Manufacturer

Texas Instruments
Haggertystr.1

D-85356 Freising

Report No. TF93594T

Revision 1.0 of 2019.02.05

Test Laboratory

TÜV SÜD Rail GmbH
Rail Automation
Barthstrasse 16
D-80339 München

Table of Contents   page

List of tables   page

List of figures   page

Revision history

Rev.	Status	Date	Author	Modification / Description
1.0	Active	2019.02.05	A.Valente	

Table 1:   Revision History

Acronyms and Abbreviations

TERMS	DEFINITIONS
Failure	The termination of the ability of a functional unit to perform a required function.
Fault	Abnormal condition that may cause a reduction in, or loss of, the capability of a functional unit to perform a required function.
MooN	M out of N channel architecture (for example 1oo2 is 1 out of 2 architecture, where either of the two channels can perform the safety function)
PFD	Probability of dangerous failure on demand
PFH	Average frequency of dangerous failure per hour
PL	Performance Level
PLC	Programmable Logic Controller
Redundancy	Existence of means, in addition to the means which would be sufficient for a functional unit to perform a required function or for data to represent information.
SIL	Safety Integrity Level

Table 2:   Acronyms and Abbreviations

TÜV SÜD Rail GmbH
Rail Automation
Barthstr. 16 • D-80339 Munich • Germany
Phone: +49 (89) 5791+49 89 5791-4222 , Fax: -2933
E-Mail: andrea.valente@tuev-sued.de

TF93594T
717518248_Concept Report.docx / Rev. 1.0
Author: A.Valente
2019.02.05
Page 3 of 7

1 Scope

Scope of this report is the concept approval for the Safety component Digital Input card from Texas Instruments. The Digital Input card is specified and described by the concept document [D1].

The Digital Input card provides safety functions according to SIL2 / PLd / CAT2 of the safety standards mentioned in chapter 2.1 .

The Safety Function of this design is the conversion of the eight digital inputs represented by defined current and voltage levels to its digital representation to the master processor.

Software is not in the scope of this concept analysis and it shall be evaluated in the end use application.
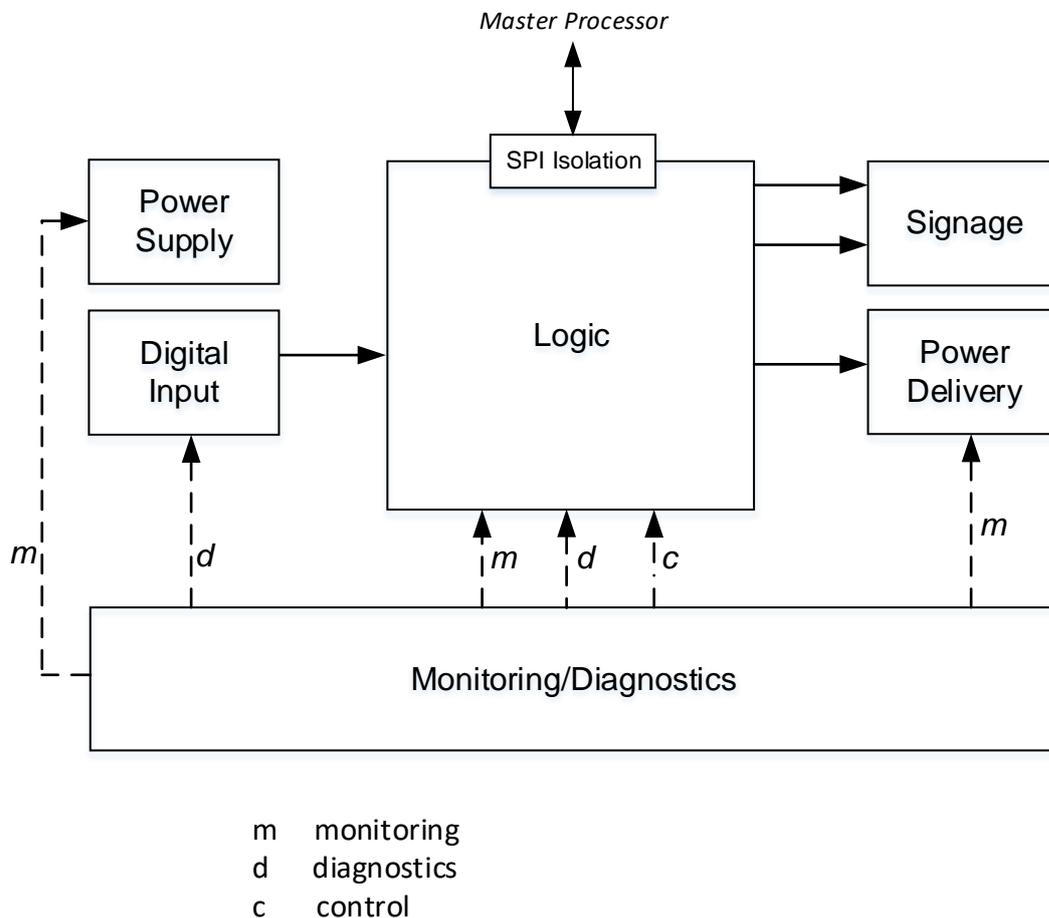

m   monitoring
d   diagnostics
c   control

Figure 1:   System overview

TÜV SÜD Rail GmbH
Rail Automation
Barthstr. 16 • D-80339 Munich • Germany
Phone: +49 (89) 5791+49 89 5791-4222 , Fax: -2933
E-Mail: andrea.valente@tuev-sued.de

TF93594T
717518248_Concept Report.docx / Rev. 1.0
Author: A.Valente
2019.02.05
Page 4 of 7

1.1 Basis of the Approval

The approval of the safety concept bases on the documents listed in clause 3 of this report. The concept was examined according to the standards and guidelines listed by clause 2 of this report. The following aspects were reviewed:

- Functional safety
  - Analysis of the system structure
  - Review of block FMEA

2   Basis of Evaluation

The regulations and guidelines which form the basis of the type testing are listed below.

2.1   Functional Safety

No.	Standard	Title
[N1]	IEC 61508-2: 2010 (SIL 2)	Functional safety of electrical/electronic/programmable electronic safety-related systems Part 2: Requirements for electrical/electronic/ programmable electronic safety-related systems
[N2]	IEC 61508-4: 2010 (SIL 2)	Functional safety of electrical/electronic/programmable electronic safety-related systems Part 4: Definitions and abbreviations
[N3]	IEC 62061/A2: 2015 (SIL CL 2)	Safety of machinery - Functional safety of safety-related electrical, electronic and programmable electronic control systems
[N4]	EN ISO 13849-1: 2015 (PL d, Cat. 2)	Safety of machinery - Safety-related parts of control systems Part 1: General principles for design

Table 3:   Functional Safety

3   Documents provided for the concept review

The following documents were provided by Texas Instruments as basis for the concept evaluation.

No.	Title	Document-No./ File identifier	Revision	Date
[D1]	Hardware Architecture description & Block FMEA	TIDA-010049-Concept_Evaluation.docx	0.91	2019.02.01
[D2]	Schematic	TIDA-010049_schematics.pdf	E2	2019.01.09

Table 4:   Documents from Customer

TÜV SÜD Rail GmbH
Rail Automation
Barthstr. 16 • D-80339 Munich • Germany
Phone: +49 (89) 5791+49 89 5791-4222 , Fax: -2933
E-Mail: andrea.valente@tuev-sued.de

TF93594T
717518248_Concept Report.docx / Rev. 1.0
Author: A.Valente
2019.02.05
Page 5 of 7

4 Performance and result of tests

4.1 Test reports

Following test reports were issued by TÜV SÜD Rail GmbH or other accredited test laboratories.

No.	Title	Document-No./ File identifier	Revision	Date
[R1]	Review Report	Review Protocol Concept v1.4.pdf	1.4	2019.02.01

Table 5: Documents from Testing Agency

5 Result of the concept review

5.1 Analysis of system architecture

The Digital Input card hardware architecture consists mainly of a single channel structure with diagnostic for the logic and the in- and outputs components, see [D1].

The basic diagnostic principles are:

- Self tests including on-chip tests
- Window-Watchdog and independent shutdown path
- Suppression and control of under and overvoltage for all power supplies

Result:

The hardware architecture (1oo1D) is generally suitable for SIL2 / PLd / CAT2 . The architecture and the effectiveness of the selected diagnostic measures have to be verified during the project detailed phase by TÜV SÜD Rail GmbH.

5.2 Block-FMEA

The manufacturer provided a block based FMEA [D1]. The FMEA considers the relevant failure modes for all the main safety blocks and analyses the failure effects.

Result:

The FMEA demonstrates that the requirements of SIL2 / PLd / CAT2 can be achieved.

The effectiveness shall be proofed during the project detailed phase from TÜV SÜD.

TÜV SÜD Rail GmbH
Rail Automation
Barthstr. 16 • D-80339 Munich • Germany
Phone: +49 (89) 5791+49 89 5791-4222 , Fax: -2933
E-Mail: andrea.valente@tuev-sued.de

TF93594T
717518248_Concept Report.docx / Rev. 1.0
Author: A.Valente
2019.02.05
Page 6 of 7

6   Summary

The concept of the Safety component Digital Input card from Texas Instruments is able to fulfil the architectural requirements in accordance to SIL2 / PLd / CAT2 of the standards mentioned in chapter 2.1.

Technical Certifier   Project Manager

M.Ramold   A.Valente